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ABSTRACT

Individuals traditionally have been diagnosed as having Attention Deficit Hyperactivity Disorder (ADHD) by using a combination of rating scales of criteria that describe symptoms of the disorder and case histories. Cut-off points are suggested in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) for the number of criteria above which individuals are considered to have the disorder. An alternative approach would be to use Rasch scaling to determine the relative frequency of each behavioral symptom. The cut-off points used at the present time imply that the more symptoms an individual shows, the greater will be their impairment. The possibility that some of the criteria might be more indicative of the severity of impairment than other items and more predictive than others of learning difficulties of young children was explored in this study. Data came from schools that were part of a study of performance indicators in elementary schools in England. Participants were 1,821 children from 70 schools. Principal components analysis was used to explore in detail the separate dimensions of inattention, hyperactivity, and impulsivity. The less frequently met items of the behavior rating scale did not appear to indicate a more severe level of impairment in terms of academic achievement . The total number of criteria met appeared to be more important than their frequency, and items related to inattention were more strongly related to achievement than criteria relating to hyperactivity/impulsivity. The highest correlation between behavior and achievement was found when a combination of a few behavior items were used. These items were within the attention subscale, but did not form a specific factor in the analysis. An appendix contains the Behavior Rating Scale used. (Contains 2 tables, 10 figures, and 19 references.) (Author/SLD)

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Rasch Analysis Of Inattentive, Hyperactive and Impulsive Behaviour In Young Children And The Link With Academic Achievement

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Abstract

Traditionally, individuals have been diagnosed as having Attention
Deficit Hyperactivity Disorder (ADHD) by using a combination of rating scales of criteria that describe symptoms of the disorder alongside case histories.
Although ADHD is best viewed as the extreme of behavioural traits present to varying degrees across the whole population, cut-off points are suggested in the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1994) for the number of criteria, above which individuals are considered to have the disorder.

An alternative, and possibly more accurate, method of identifying children who might be at risk of the negative outcomes associated with ADHD is to use Rasch scaling to determine the relative frequency of each behavioural symptom. This can be contrasted with the relationship between each symptom and the academic achievement and progress of young children.
The cut-off points used at the present time imply that the more symptoms an individual shows, the greater will be their impairment. The possibility that some of the criteria might be more indicative of the severity of impairment than other items and more predictive than others of learning difficulties of young children is explored in this paper.
Additionally, principal components factor analysis was used to explore in detail the separate dimensions of inattention, hyperactivity and impulsivity.

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Introduction

Some young children display an exceptionally severe level of inattentive or hyperactive and impulsive behaviour compared with others of the same age, developmental level and gender, and this exceptional behaviour does not always improve with age. Although this behaviour might be a consequence of one of several factors, it is possible that these children have the condition known as Attention Deficit Hyperactivity Disorder (ADHD). Three subtypes of ADHD have been identified: Predominantly Inattentive, where individuals mainly have symptoms of inattention, Predominantly Hyperactive/Impulsive, where individuals mainly have symptoms of hyperactivity and impulsive behaviour, and Combined, where individuals have symptoms of inattention, hyperactivity and impulsivity. The behaviour of individuals might change with increasing maturity but ADHD persists into adulthood in many cases (Barkley, 1997). ADHD is thought to be a result of impaired executive functions and more specifically, for some aspects of ADHD, of behavioural inhibition (Barkley, 1997). Barkley has suggested that the attention deficit in individuals diagnosed as Predominantly Inattentive was due to their poor speed of information processing and problems with focussed and selective attention, whereas the attention deficit in the Combined type was due to a deficit in sustained attention and increased distractibility brought about by an impairment in behavioural inhibition.

The Diagnostic and Statistical Manual of Mental Disorders Version 4 (DSM-IV) (American Psychiatric Association, 1994) recommended that for children to be diagnosed as having ADHD, they must meet at least 6 out of 9 criteria relating to inattention for the Predominantly Inattentive subtype and at least 6 out of 9 criteria relating to hyperactivity and impulsivity for the Predominantly Hyperactive/Impulsive subtype. For the Combined subtype they must meet both of the above conditions. Behavioural problems should be evident in at least two different environments (e.g.

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school and home), have persisted for at least six months, and some symptoms should have been present before the individual was 7 years old.

The cut-off points of criteria for the diagnosis of ADHD suggested in the DSM-IV do not recognise that some of the criteria might be less frequently achieved than others nor that some items might be more indicative of the severity of impairment than other items. Further, if as Barkley suggested, the inattentive behaviour of the Predominantly Inattentive and Combined subtypes are a result of an impairment of different executive functions, the characteristics of items in the inattentive scale and therefore the interpretation of the scale itself might be different for each subtype. Finally it should be noted that some ADHD symptoms might impact on the learning and academic achievement of children, with or without a formal diagnosis of ADHD, more than others. ..

Smith and Johnson (2000) used Rasch scaling to investigate some of the issues raised in the previous paragraph when they analysed the inattentive, hyperactive and impulsive behavioural characteristics of college students. The students in their study completed a modified version of the self-report 'Adult Behaviour Checklist' (ABC-R) devised by Johnson and Lyonfields (1995) on which behaviour was rated on a 4 point Likert-type scale. The ABC-R included twenty-four items associated with symptoms of ADHD and represented all the DSM-IV criteria. Smith and Johnson used BIGSTEPS (Linacre and Wright, 1995) for their analyses of the students' responses. Firstly, the items in the ABC-R were placed in a hierarchy from the least frequently experienced to the most frequently experienced. On the inattentive subscale, students most frequently reported being easily distracted by extraneous stimuli, disliking and being reluctant to engage in tasks that required sustained mental effort. The least frequently reported were failing to finish work duties, not listening when spoken to directly and not following through instructions. On the hyperactive/impulsive subscale, the most frequently reported items were

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constantly being 'on the go' and acting as if driven by a motor. The least frequent behaviours were blurting out answers, having difficulty awaiting turn and interrupting and intruding on others. The least frequent behaviours on the hyperactive/impulsive subscale were all related to impulsivity rather than hyperactivity. Barkley, (1990) and Wender (1995) have suggested that as children with ADHD get older, the overt symptoms of hyperactivity and impulsivity are replaced by covert feelings of restlessness and agitation. Smith and Johnson commented that their data supported those suggestions since overt behaviours such as blurting out answers, interrupting, having difficulty remaining quiet were reported less frequently than being continually 'on the go'.

They investigated the separate dimensions of inattention and hyperactivity/impulsivity in the college students and the possible existence of further, secondary, components within each scale with a principle component factor analysis of residuals derived from the Rasch model. When the full set of items was analysed, two separate dimensions (inattention and hyperactivity/impulsivity) were found. For the inattentive items, within the first principle component there was a grouping of items associated with avoidance of tasks that required sustained mental effort. Within the second component, a further two variables were present – the first included items that indicated a reluctance to finish work the second included items that indicated the tendency to be easily distracted. Within the hyperactive/impulsive items, those relating to hyperactivity were clearly separate from those relating to impulsivity.

The research by Smith and Johnson focused on college students, many of whom were undergraduates studying psychology or education. The sample represented a population of individuals that perhaps experienced mild behavioural difficulties, or who were capable of achieving a level of academic success in spite of existing behavioural problems. Those factors might have contributed to a hierarchy

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of symptoms atypical of individuals with ADHD or of individuals with severe inattention, hyperactivity and impulsivity (but no formal diagnosis of ADHD). Further, younger inattentive, hyperactive and impulsive children might well demonstrate different behavioural characteristics. As mentioned earlier, ADHD-like behaviour tends to become more covert with age and maturity and this may result in a different hierarchy of symptoms for young children. (ah Christine, this makes me think that we should like at the correlation between the Rasch scores from theirs and ours. I know that you won't want to start doing that now that things are just about wrapped up but I am sure alos that you will see the sense of it) The Smith and Johnson paper also suffers from a lack of any data other than student self-ratings.

This study aims to estimate the frequency of ADHD symptoms for a school-based sample of children aged 4 and 5 years and to compare those findings with the results of Smith and Johnson using the same methods of Rasch scaling. A further aim is to classify symptoms using factor analysis and to compare the resultant classification with the recognised groups of Predominantly Inattentive and Predominantly Hyperactive/Impulsive and also with the findings of Smith and Johnson.

Severe inattentive, hyperactive and impulsive behaviour has been found to be negatively associated with the attainment and progress of young children (Merrell and Tymms, 2001) and a third aim of this study is to examine the relationship between individual ADHD symptoms and the academic achievement of these children over their first three years at school. The predictive importance of the items can then be related to their measurement values derived from Rasch scaling.

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Method

The reading and mathematics achievements of a single cohort of pupils were assessed at three time points: on entry to school (Reception) when the pupils were aged 4 to 5 years, at the end of the Reception year, and in the second term of Year 2 when the pupils were aged 6 to 7 years. Vocabulary and non-verbal ability were assessed in Year 2. Additionally, teachers rated the inattentive, hyperactive and impulsive behaviour of their pupils at the end of Reception.

Data for this study have come from schools who were part of the Performance Indicators in Primary Schools (PIPS) project run by the Curriculum Evaluation and Management (CEM) Centre, University of Durham (www.cem.dur.ac.uk). PIPS is paid for by participating schools and it enables teachers to monitor the progress of pupils as they move through primary school, (see for example Tymms, Merrell and Henderson, 2000, Tymms,1999a). Assessments that have been developed by PIPS are administered to pupils and then returned to the CEM Centre where they are marked and analysed. Detailed, confidential, feedback about the attainment and progress of pupils in relation to nationally representative data is returned to schools. As a consequence of this process, the CEM Centre holds a large dataset tracking pupils longitudinally that can be also used for research purposes such as this study. The project analyses data from almost half a million pupils every year.

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Sample

The participants of this study were a single cohort of 1821 children (52.3% boys and 47.7% girls) from 70 schools is England. The vocabulary and non-verbal ability of the pupils in the sample indicated that their cognitive developmental levels were slightly higher than the English average.[1]

Measures

The behaviour rating scale

The rating scale was based on the 18 criteria for the diagnosis of ADHD in DSM IV. (For a copy of the behaviour rating scale and further notes of how it differed from the DSM-IV recommendations, see Appendix 1.) The criteria on the behaviour rating scale were grouped to form subscales of the same ADHD subtypes as the DSM-IV.

Attainment

Start of Reception

The assessment administered at the start of reception measured vocabulary, writing, phonological awareness, concepts about print, letter identification, word recognition, counting, sums, sequencing and digit identification (Tymms 1999a). It was administered on an individual basis either by the class teacher, head teacher or classroom auxiliary, and took approximately 15 minutes per child.

[1] The PIPS assessment for pupils in Year 2 (aged 6 to 7 years) included measures of vocabulary and non-verbal ability, which gave an indication of the developed ability of pupils. Scores from each section of the PIPS assessments were transformed to T scores and for pupils from a nationally representative sample of schools, the mean = 50 and standard deviation = 10. The vocabulary and non-verbal ability of the sample of pupils in this study were slightly higher than the national average (for vocabulary the mean = 52.26, standard deviation = 9.79 and for non-verbal ability the mean = 51.30, standard deviation = 8.04).

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End of Reception

An extended version of the start of Reception assessment (which included more difficult words and stories to read and more difficult maths problems) was administered, again on an individual basis.

Year 2

This was a group assessment made up of three sections (reading, mathematics and context), each taking half an hour to complete. The context section included measures of picture vocabulary, and non-verbal ability. The reading and mathematics sections were created to reflect the content of the English National Curriculum (Department for Education and Employment, 1995).

The scores from all PIPS assessments were transformed to T scores. See Footnote 1 for details.

Reliability and validity of the measures

The test-retest reliability and validity of the reception assessment, internal reliability (α) and validity of each section of the Year 2 assessment were high (www.pipsproject.org), and the test-retest reliability and validity of the behaviour rating scale indicated a high consistency of use between teachers (Merrell and Tymms, 2001).

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Analyses and Results

Hierarchy and classification of ADHD symptoms

The WINSTEPS computer program (Linacre and Wright, 2001) was used to conduct the analyses.

The first stage in the analysis involved using the Rasch scaling to create an equal interval measure (see for example Bond and Fox, 2001) of all 18 items from the behaviour rating scale. From an initial analysis, 57 children were found to have very unexpected scores, giving them extreme 'Outfit' values (greater than/equal to 2.0 or less than/equal to 0.5). These children were removed and the dataset re-analysed. The remaining data were used to produce Figure 1, which shows the Item Map of the whole scale.

INSERT FIGURE 1 HERE

The map indicates that the ADHD items spread over about 4 logits in range. The least-likely-to-be-endorsed item was "loses equipment" and this was checked for just 5% of the children. The most-likely-to-be-endorsed item was "easily distracted by extraneous stimuli" and it was checked for 36%. The teachers indicated that for a large proportion of 4 to 5 year olds none of the items on the scale applied (47%).

A principal component analysis of residuals (see Wright, B.D.,2000) of all items on the behaviour rating scale differentiated between the items related to inattention and those related to hyperactivity/impulsivity (Figure 2) with an Eigenvalue of 2.9. This is well above the Eigenvalue of 1.4 which the simulation work of Smith (1994) suggested was sufficient to show that more than one component is present.

INSERT FIGURE 2 HERE

All of the items with positive factor loadings related to hyperactivity/impulsivity and the items with negative factor loadings related to inattention.

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The items in the inattentive and hyperactive/impulsive sub-scales were then analysed separately.

INSERT FIGURE 3 HERE

Figure three shows the Rasch scaling of the items from the sub-scale relating to inattentiveness. The items cover a range of about 5 logits. As with the full scale analysis the least-likely-to-be-endorsed item was "loses equipment" and the most-likely-to-endorse item was "easily distracted". Fifty two percent of pupils were given no endorsements on the inattentive sub-scale by their teachers.

Figure 4 shows the map for the items relating to impulsiveness/hyperactivity.

INSERT FIGURE 4 HERE

The scale covers just over 2 logits and ranges from the least-likely-to-be-endorsed item, which was "runs excessively", to the most-likely-to-endorsed item, which was "fidgets". Sixty five percent of pupils were given no endorsements on the impulsiveness/hyperactivity sub-scale by their teachers.

Principal component analyses of the inattentive sub-scale gave some interesting results but low Eigenvalues, below the suggested cut-off point of 1.4. The Eigenvalue of factor 1 was 1.3. Item 8 ('is distracted by extraneous stimuli') was separated from the other items with a positive loading of 0.68. Items 4 and 5 ('Does not follow through instructions, fails to finish work' and 'Has difficulty organising tasks and activities') were grouped with negative loadings of –0.55 and –0.52 respectively). Factor 2 within the inattentive subscale separated item 1 ('Makes careless mistakes') from the others with a positive loading of 0.92. The Eigenvalue of factor 2 was 1.2. Factor 3 also had a low Eigenvalue (1.2) but item 3 ('Doesn't listen properly') was separate to the other items with a positive loading of 0.75. A second pair of items (7, 'Loses equipment' and 5, 'Has difficulty organising') had negative loadings of –0.51 and –0.47 respectively.

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A principal component analysis of the hyperactive/impulsive subscale gave an Eigenvalue of 1.9 for factor 1 which is above the suggested cut-off of 1.4. The three items related to impulsivity (16, 17 and 18) were grouped with positive loadings of 0.5 and higher, indicating that they were a separate component to the hyperactivity items. Four items (10 'fidgets with hands or feet or squirms in seat', 11 'leaves seat in classroom or in other situations where remaining seated is expected', 12 'often runs about excessively in situations in which it is inappropriate' and 14 'Is often 'on the go' as if driven by a motor') were grouped with negative loadings of -0.58, -0.53, –0.49 and –0.35 respectively. These items can be termed "Physical Hyperactivity". Figure 5 shows the data.

INSERT FIGURE 5 HERE

This leaves two items (13 'has difficulty playing quietly' and 15 'talks excessively') hanging together and these can be termed Verbal Hyperactivity.

Factor 2 had an Eigenvalue of 1.4, just on the borderline of the cut-off value of 1.4, and grouped the two items identified as Verbal Hyperactivity with loadings of 0.66 and 0.53 respectively. The appearance of this grouping within the second factor is taken as some confirmation of their meaningful association in factor 1.

The results of these principal component analyses are summarised in Figure 6.

INSERT FIGURE 6 HERE

Types of Inattention

It was suggested in the introduction that individuals with the Combined subtype of ADHD might meet different criteria for inattention to individuals with the Predominantly Inattentive subtype. In particular, Barkley (1997) suggested that individuals with the Combined subtype had a deficit in sustained attention and increased distractibility brought about by impaired behavioural inhibition, whereas

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individuals with the Predominantly Inattentive subtype were slow to process information and experienced problems with focused and selective attention. If this is correct then items 2 ("Has difficulty sustaining attention in tasks of play activities") and 8 ("Is easily distracted by extraneous stimuli") should be less important for the purely inattentive group than for the combined type. Figure 7 shows a plot of the Rasch scale score of each item in the inattention subscale of the group of children within the sample who met only criteria relating to inattention (the pure inattention group) against the children within the sample who met criteria relating to inattention, hyperactivity and impulsivity (the combined group). The 95% confidence intervals for each point apart from items 2 and 8 have been plotted. The lines show the overall 95% confidence intervals.

INSERT FIGURE 7 HERE

Is it interesting to look at items 2 and 8 in terms of how closely their scores matched the expected values for the 'pure' and 'impure' (combined) groups. Item 8 appears to behave differently for the pure and combined groups in exactly the way the Barkley suggests. (This might help to explain why the factor analysis separated item 8 but not clearly so.) The situation is not quite so clear with item 2 however. It appears to be a little less important for the combined group but only marginally so.

How closely do the data from the behaviour rating scale fit the expected item characteristic curves?

The data from items on the behaviour rating scale matched the expected item characteristic curves very closely. Three examples have been included in the paper: Item 8 for the whole sample, the 'pure' inattentive group and the group with 6 or more symptoms of inattention and also some symptoms of hyperactivity/impulsivity (combined). The empirical data match the expected data very closely in all cases but they are particularly discriminating for the combined group.

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INSERT FIGURES 8, 9, AND 10 HERE

Academic achievement and inattentive, hyperactive and impulsive behaviour

Correlations between individual items on the behaviour rating scale and achievement at three time points, the start and end of Reception and Year 2, were calculated and are reported in Table 1. The items relating to inattention clearly correlated more highly with achievement than those related to hyperactivity/impulsivity. Those results parallel the findings by Merrell and Tymms (2001) that the academic achievement and progress of children who are predominantly inattentive or are a combination of inattentive, hyperactive and impulsive is lower than their peers. The achievement and progress of children who are predominantly hyperactive and impulsive is not as low as for the two other groups.

INSERT TABLE 1 HERE

The columns of correlations correlate with one another very highly and never below 0.97 suggesting that the relationship between the items and academic attainment remained constant during the first three years of schooling. This may have a broader implication than is first apparent since the Year 2 scores of reading and maths were measures of what pupils had learnt during their first three years at school whereas the measures at the start of reception were measures of developmental levels on entry to school. There were also no differences between the measures for maths and reading.

The highest correlations between behaviour and achievement were found for Items 2, ('Has difficulty sustaining attention in tasks or play activities'), 5 ('Has difficulty organising tasks and activities') and 6 ('Is reluctant to engage in tasks which require sustained mental activity'). The lowest correlations between behaviour and

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achievement were found for items relating to hyperactivity and impulsivity. Less frequently met criteria on the behaviour rating scale are indicative of greater impairment and it might therefore be expected that the correlation between those individual items and achievement would be higher than the correlations between frequently met criteria and achievement. That did not appear to be the case as Table 1 shows.

The items were also combined into the two sub-scales of inattention and hyperactivity/impulsivity. The correlations between each sub-scale and achievement are shown in Table 2.

INSERT TABLE 2 HERE

Surprisingly perhaps the correlations of achievement with the scaled scores were only marginally higher than the correlations with some of the individual items.

The maximum multiple correlations between items on the behaviour rating scale and achievement were found using stepwise regression. A combination of items 1, 2, 5, 6 and 8 were found to be the best predictors of reading in Year 2 with a correlation of 0.43. A combination of items 1, 2, 3, 5, 6 and 8 were found to be the best predictors of mathematics in Year 2 with a correlation of 0.44.

These items were all from the inattention subscale. Items 2, 6 and 8 are concerned with focussing and sustaining attention and therefore seem to have an obvious connection with academic success. Making careless mistakes (item 1) seems a likely outcome of not focussing and sustaining attention on a task. They were also some of the more frequently observed behaviours.

Pupils and Items with unexpected values

As mentioned earlier, 57 pupils with extreme 'Outfit' values were excluded from the analysis. Although the test/retest reliability of the behaviour rating scale

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indicated that teachers tended to score children consistently and that the behaviour remained stable over time, there is always a chance that a small number of teachers may complete the scale inaccurately. For example, they might have a tendency to tick the first item for all pupils in their class without due regard to the criterion. The data were further analysed to look for whole classes of pupils with atypical scores. When the most outlying pupils (highest outfit scores) were examined, it was found that they tended to come in clusters and that the clusters were of pupils within one class. This pattern in data can be interpreted on one of two ways. Either some teachers were applying the behaviour rating scale in idiosyncratic ways or pupils in some classes are behaving in similar but unusual ways. This could be because a particular teaching style has caused a behaviour pattern or, possible because a pair or group of pupils has generated behaviour patterns amongst themselves. This is an interesting pattern within the data and it warrants further investigation.

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Discussion

Comparing the results of this study with those of Smith and Johnson, on the inattentive sub-scale, similar items tended to be similarly placed on both scales (with a correlation of around 0.6). For example the most frequently met item, 'easily distracted by extraneous stimuli', was in the same position in the hierarchy and had approximately the same Logit value. One item that particularly differed was 'forgetful in daily activities', which was more frequently met by college students than by young children. College students have to take responsibility for remembering information and arrangements, and they are no-doubt aware of the problems that entails. Younger children are probably not given the same level of responsibility and are also often given shorter tasks, which might explain the difference between the two studies. The least frequently met item of the entire behaviour rating scale was 'loses equipment necessary for activity, e.g. pencils, books'. Again, this statement might be less applicable to young children who perhaps do not take responsibility for equipment. Teachers will often provide specific resources for each activity and collect them as soon as the pupils are finished. Although losing equipment was an infrequently met item, the factor analysis did not indicate that it formed a component that was different from the other items. On the hyperactive/impulsive sub-scale, the hierarchy of items was very different for the two studies (with a correlation of around –0.5). Young children were frequently found to blurt out answers to questions before they were finished, have difficulty awaiting turn, interrupting and intruding on other children's conversations and games, whereas college students were more likely to experience problems associated with feeling as though they were constantly 'on the go'. This supports the suggestion by Barkley, (1990) and Wender (1995) that as children with ADHD get older, symptoms of hyperactivity and impulsivity are replaced by feelings of restlessness and agitation.

When Smith and Johnson conducted a principal component analysis on each subscale, they found that items describing impulsive behaviour were grouped

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separately to the items describing hyperactive behaviour within the hyperactive/impulsive items, and that a reluctance or avoidance to engage in tasks that required sustained mental effort formed a group separate to the rest of the inattention items. This study found the same trend for the hyperactive/impulsive sub-scale and that difficulty sustaining attention and being easily distracted by extraneous stimuli formed a group separate to the rest of the inattentive sub-scale.

It has been suggested that inattentive behaviour might have a different cause depending upon whether or not it occurs in isolation or in combination with hyperactive/impulsive behaviour and that children who are predominantly hyperactive and impulsive might also experience particular difficulties in sustaining attention and being easily distracted by extraneous stimuli. The results of this study supported that theory.

The less frequently met items of the behaviour rating scale did not appear to indicate a more severe level of impairment in terms of academic achievement e.g. item 7 (loses equipment necessary for activity, e.g. pencils, books) and item 12 (often runs about excessively in situations in which it is inappropriate) were in fact two of the least strongly correlated with achievement. The total number of criteria met appeared to be more important than their frequency and items relating to inattention were more strongly related to achievement than criteria relating to hyperactivity/impulsivity. The highest correlation between behaviour and achievement was found when a combination of a few behaviour items were used. Those items were all within the inattention subscale but did not form a specific factor in the principal component analysis.

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References

American Psychiatric Association, (1994). Diagnostic and Statistical Manual of Mental Disorders. Washington D.C., American Psychiatric Association.

Barkley, R. A. (1990). Attention Deficit Hyperactivity Disorder: A handbook for diagnosis and treatment. New York, Guilford.

Barkley, R.A. (1997) Advancing Age, Declining ADHD. American Journal of Psychiatry. 154 (9): 1323 – 1324.

Barkley, R.A. (1994) Delayed responding and attention deficit hyperactivity disorder: Toward a unified theory, In Disruptive behavior disorders in children: Essays in honour of Herbert Quay Ed. Routh, D.K., Pub. Penum, New York: 11 – 57.

Bond, T. G. and C. M. Fox (2001). Applying the Rasch Model: Fundamental Measurement in the Human Sciences. Mahwah, NJ, Lawrence Erlbaum Associates.

Conners, C.K. (1995) Conners' Continuous Performance Test Computer Program. Multi-Health Systems Inc., Toronto, Canada.

Department for Education and Employment, (1995). Mathematics in the National Curriculum. London, HMSO.

Department for Education and Employment (1995). English in the National Curriculum. London, HMSO.

Johnson, B.D. and Lyonfields. S. (1995) ADHD and college students: How useful are the DSM-IV criteria? 103rd Annual Convention of the American Psychological Association, New York.

Linacre, J.M. and Wright, B.D. (1995) BIGSTEPS Computer Program. MESA Press, Chicago.

Linacre, J.M. and Wright, B.D. (2001) WINSTEPS Computer Program. MESA Press, Chicago.

Merrell, C. and Tymms, P. (2001). Inattention, hyperactivity and impulsiveness: Their impact on academic achievement and progress. British Journal of Educational Psychology 71: 43 - 56.

Smith, R.M, and Miao, C.Y. (1994) Assessing unidimensionality for Rasch measurement. Chapter 18 in M. Wilson (Ed.) Objective Measurement: Theory into Practice. Vol. 2. Norwood NJ: Ablex.

Smith, E.V.Jr. (2002). Detecting and Evaluating the Impact of Multidimensionality using Item Fit Statistics and Principal Component Analysis of Residuals. Journal of Applied Measurement, 3(2): 205 – 231.

Smith, E.V. and Johnson, B.D. (2000). Attention Deficit Hyperactivity Disorder: Scaling and Standard Setting using Rasch Measurement, Journal of Applied Measurement. 1 (1): p3 – 24.

Tymms, P. (1999a). Baseline Assessment and Monitoring in Primary Schools. London, David Fulton.

Tymms, P. B. (1999b). Baseline Assessment, value-added and the prediction of reading. Journal of Research in Reading 22(1): 27-36.

Tymms, P., Merrell, C., and Henderson, B. (2000). Baseline assessment and progress during the first three years at school. Educational Research and Evaluation 6(2): 105 - 129.

BEST COPY AVAILABLE

Wender, P.H., (1995) Attention Deficit Hyperactivity Disorder in adults. Oxford University Press, New York.
Wright, B.D. (2000) Conventional factor analysis vs Rasch residual factor analysis *Rasch Measurement Transaction* 14:2 pp 753
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Appendix 1 Behaviour Rating Scale

Score 1 mark for each statement which has generally applied to the child during their time in your class. Consider a criterion met only if the behaviour has persisted for at least six months and is considerably more frequent than that of most other children of the same gender and developmental level.

Section B1

1 Makes careless mistakes in school work or other activities.

2 Has difficulty sustaining attention in tasks or play activities.

3 Does not seem to listen when spoken to directly.

4 Does not follow through instructions, fails to finish work.

5 Has difficulty organising tasks and activities.

6 Is reluctant to engage in tasks which require sustained mental activity.

7 Loses equipment necessary for activity e.g. pencils, books.

8 Is distracted by extraneous stimuli.

9 Forgetful in daily activities.

Section B2

10 Fidgets with hands or feet or squirms in seat.

11 Leaves seat in classroom or in other situations where remaining seated is expected.

12 Often runs about excessively in situations in which it is inappropriate.

13 Has difficulty in playing quietly.

14 Is often 'on the go' as if driven by a motor.

15 Talks excessively.

Section B3

16 Blurts out answers before questions have been completed.

17 Has difficulty awaiting turn.

18 Interrupts or intrudes on others e.g. pushes into conversations or games.

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N.B. Although this behaviour rating scale includes the same number of items as the diagnostic criteria for ADHD from the DSM-IV, since this scale was for use with young children in the classroom, items have been modified when the DSM-IV refers to behaviour being apparent outside school or are more applicable to adults or older children. For example, the DSM-IV criterion 'Often does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behaviour or failure to understand instructions)' has been modified to 'Does not follow through instructions, fails to finish work.' This was considered to be appropriate to younger children and it was intended that teachers would assume the criteria applied after they were sure that the child had understood what was required of them.

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Figure 1 Item map for the behaviour rating scale

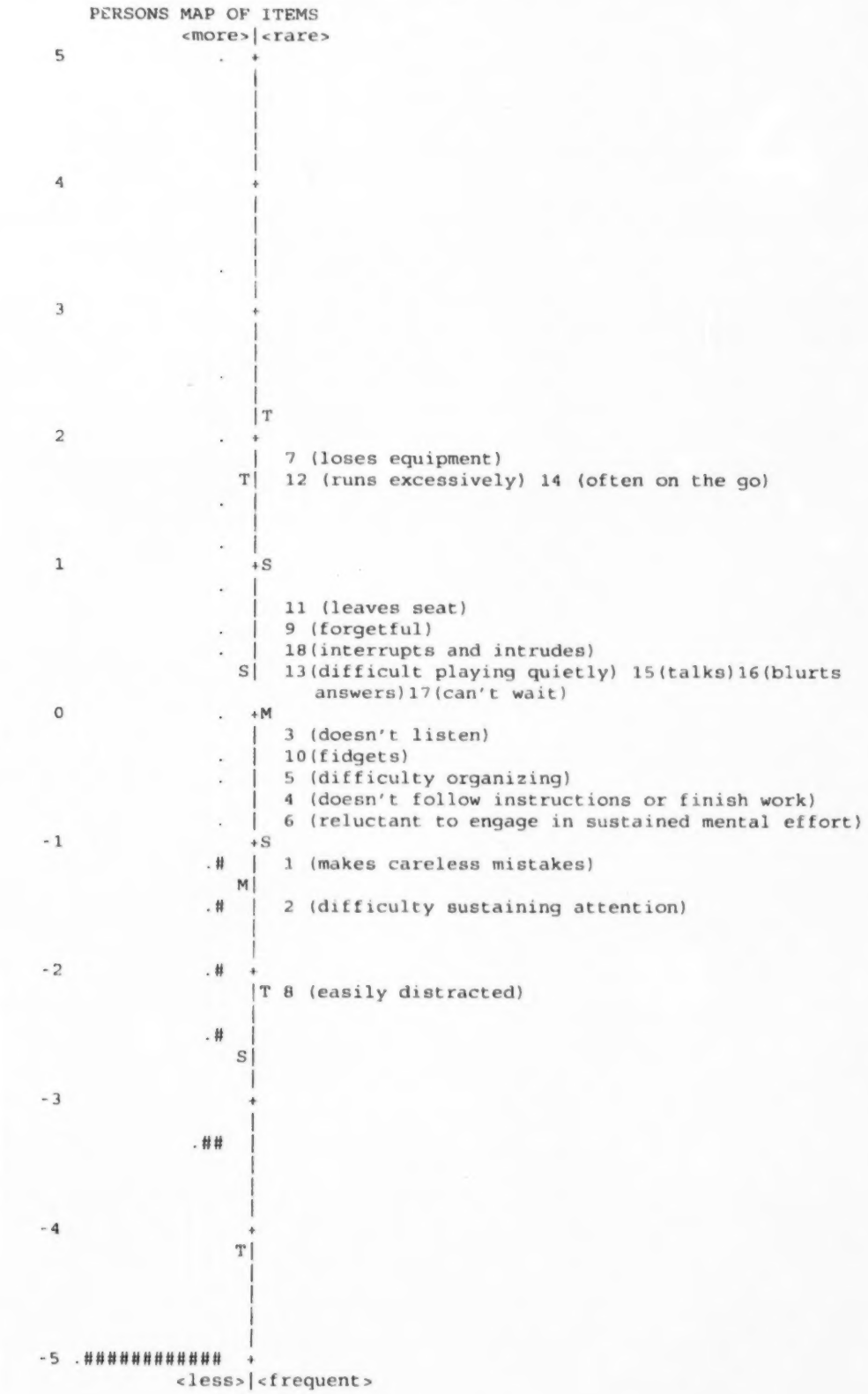

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Figure 2 Principal Components (Standardised Residual) Factor Plot of the Full Behaviour Rating scale

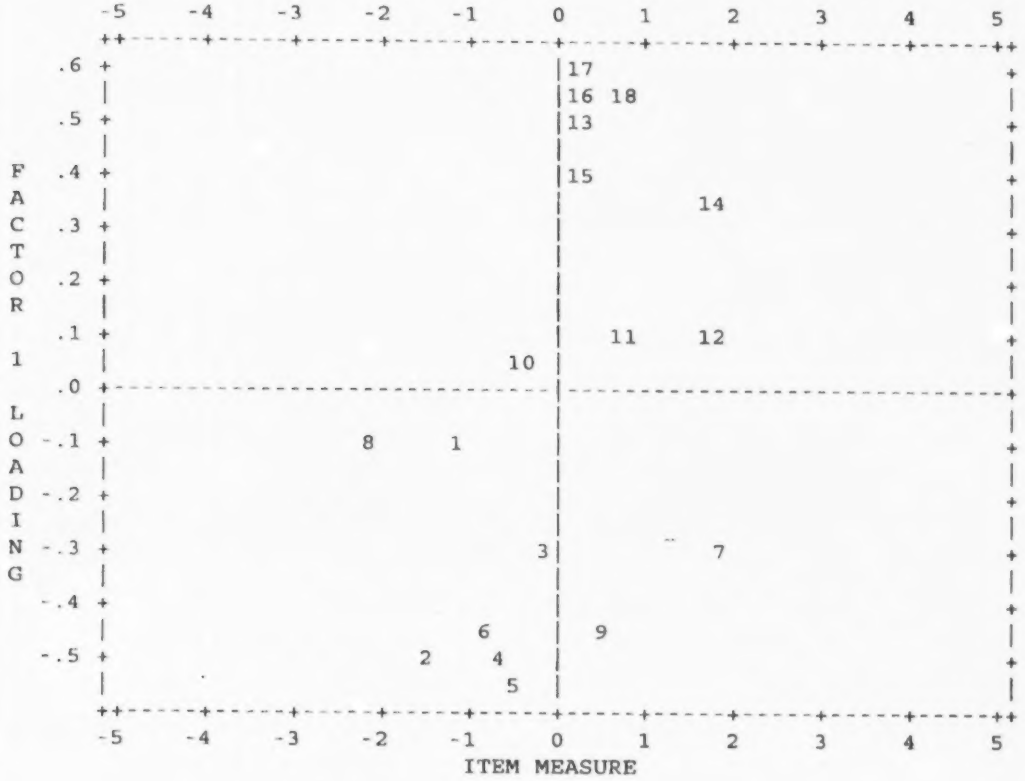

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Figure 3 Item Map for the Inattentive sub-scale

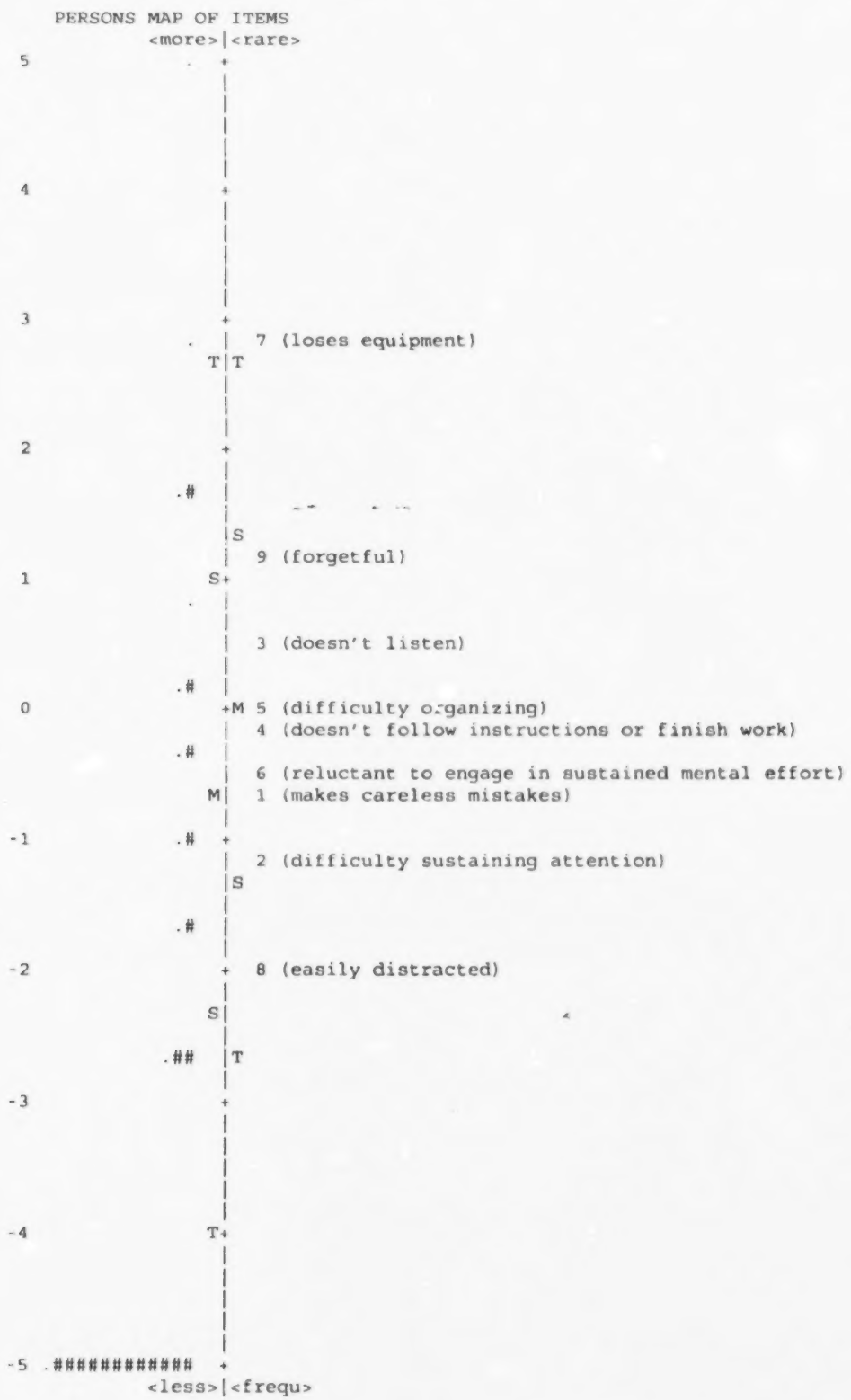

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Figure 4 Item Map for the Hyperactive/Impulsive sub-scale

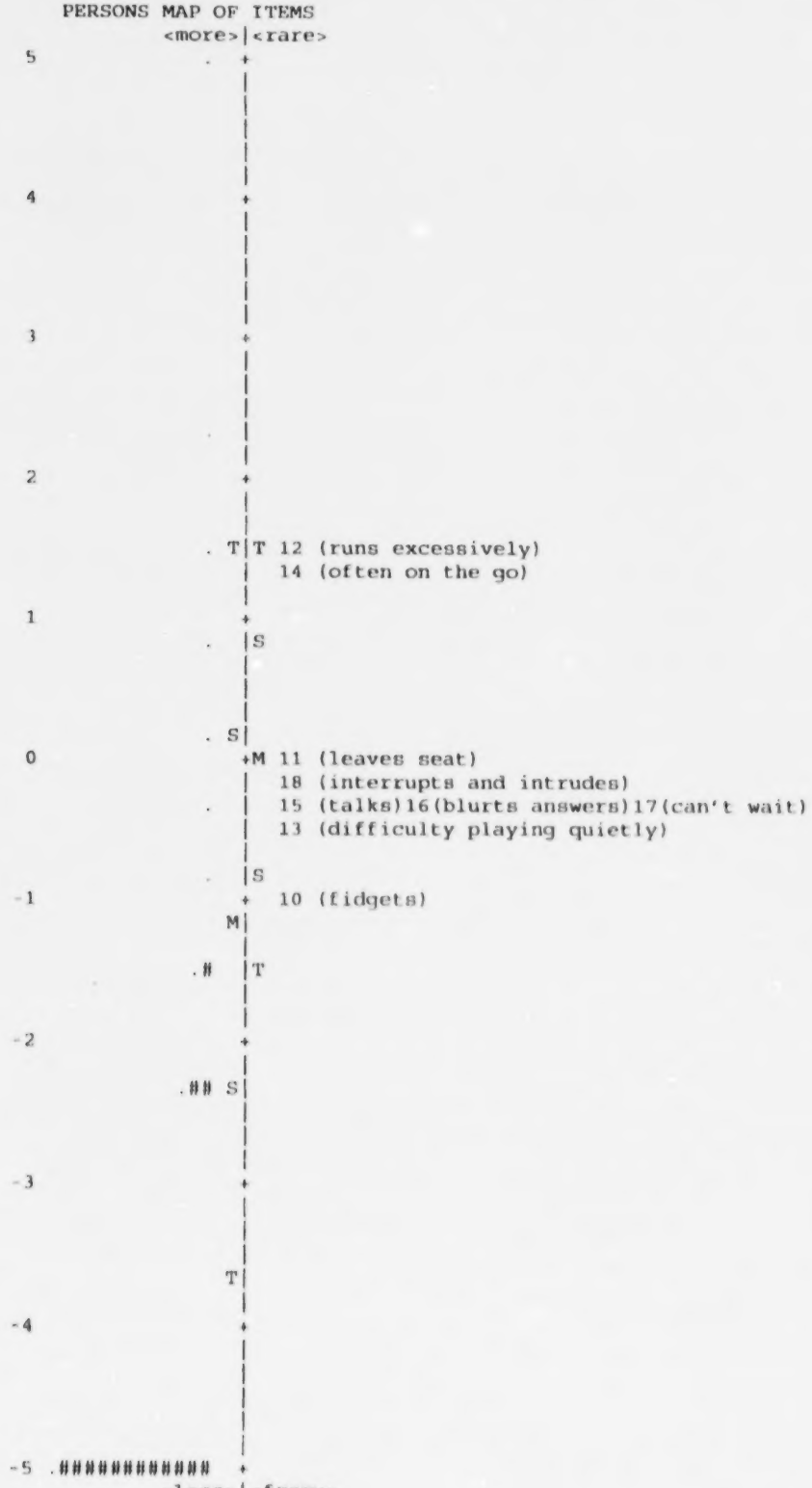

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Figure 5 Principal Components (Standardised Residual) Factor Plot of Hyperactive/Impulsive Items

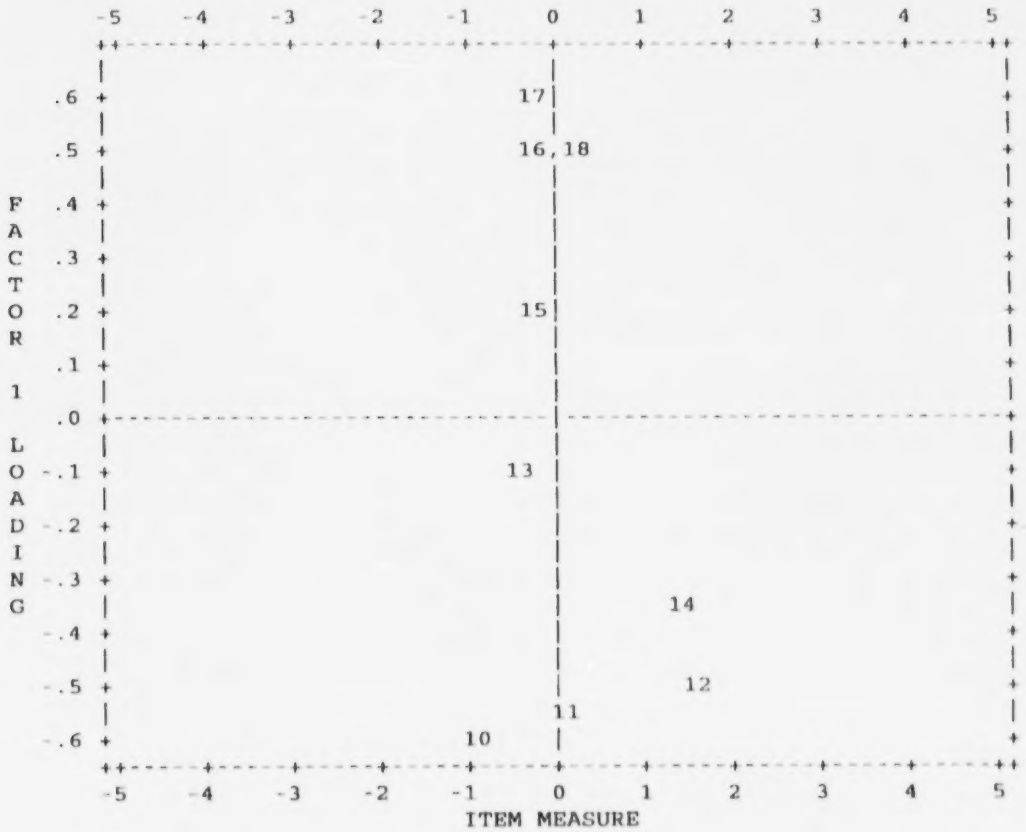

Figure 6 Summary of principal component analyses

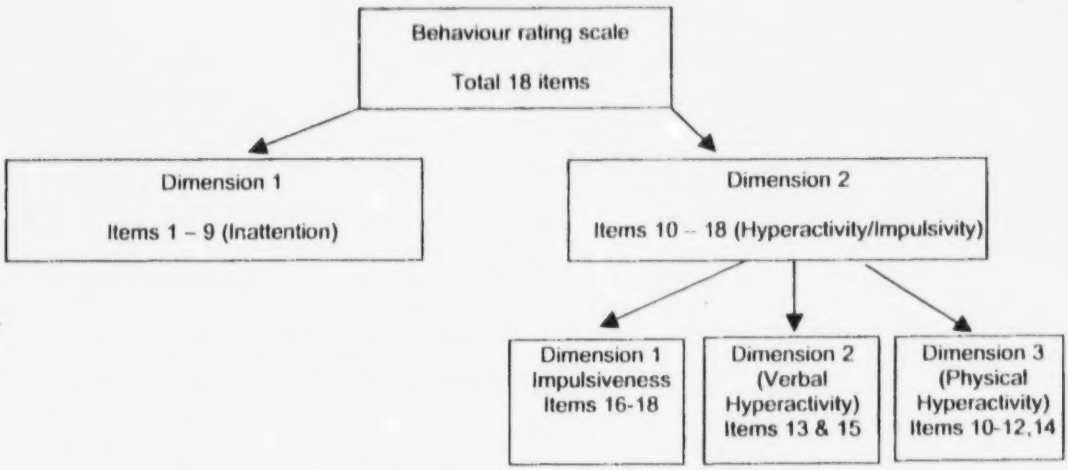
Behaviour rating scale
Total 18 items
Dimension 1
Items 1 – 9 (Inattention)
Dimension 2
Items 10 – 18 (Hyperactivity/Impulsivity)
Dimension 1 Impulsiveness Items 16-18
Dimension 2 (Verbal Hyperactivity) Items 13 & 15
Dimension 3 (Physical Hyperactivity) Items 10-12,14

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Figure 7 Plot of Rasch scale logit scores for children with pure inattentive behaviour (pure) and children with a combination of inattentive, hyperactive and impulsive behaviour (combined)

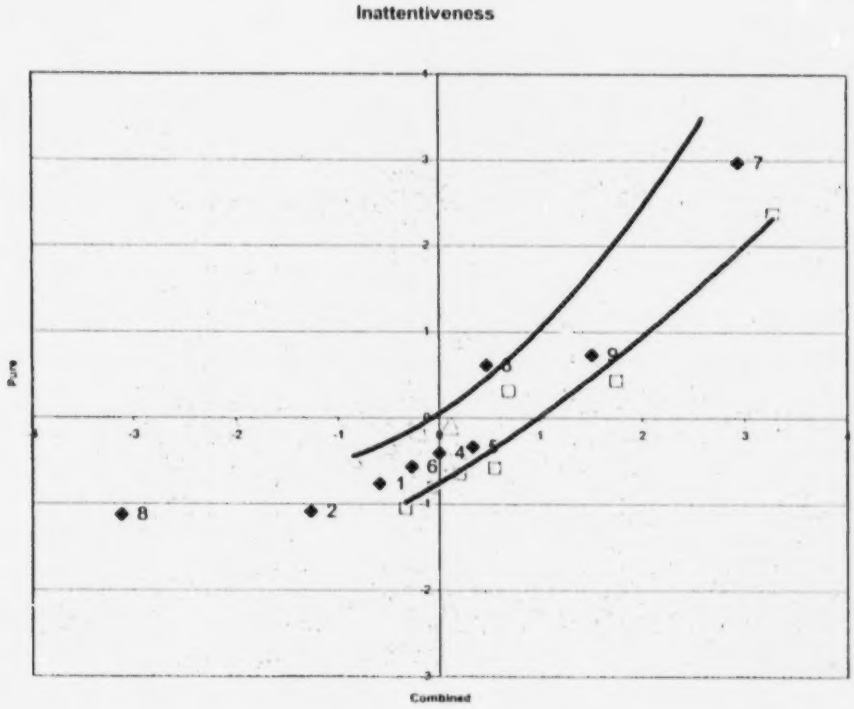

Figure 8 Item Characteristic Curve for Item 8 of the whole sample

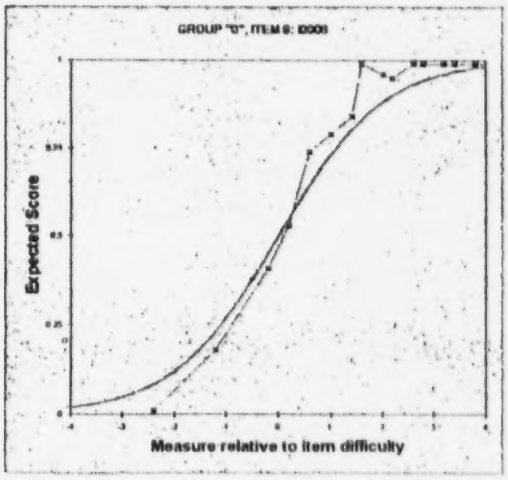

Figure 9 Item Characteristic Curve for Item 8 of the combined group

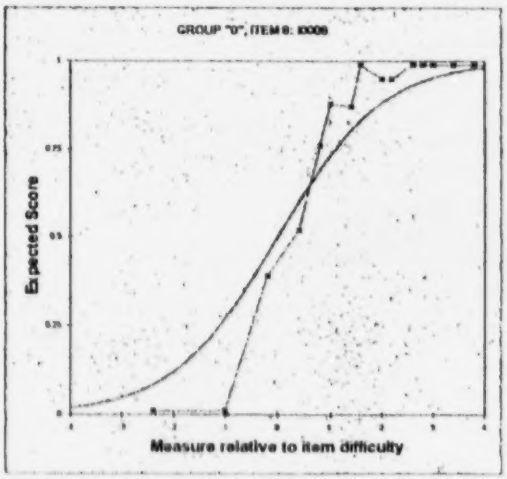

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Figure 10 Item Characteristic Curve
For Item 8 of the pure inattentive group

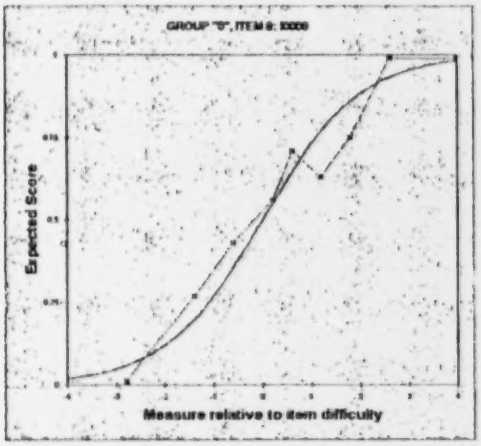

Table 1 Correlations between behaviour and achievement

Dimen -sion*	Item	Start of Reception reading	Start of Reception maths	End of Reception reading	End of Reception maths	Year 2 reading	Year 2 maths
I	1	-0.12	-0.14	-0.21	-0.21	-0.20	-0.20
I	2	-0.28	-0.32	-0.37	-0.38	-0.38	-0.37
I	3	-0.23	-0.26	-0.30	-0.30	-0.28	-0.30
I	4	-0.19	-0.23	-0.29	-0.30	-0.29	-0.30
I	5	-0.28	-0.33	-0.36	-0.38	-0.34	-0.35
I	6	-0.30	-0.33	-0.37	-0.36	-0.34	-0.36
I	7	-0.13	-0.15	-0.16	-0.18	-0.16	-0.16
I	8	-0.27	-0.31	-0.38	-0.36	-0.34	-0.34
I	9	-0.22	-0.23	-0.28	-0.29	-0.26	-0.27
PI	10	-0.20	-0.22	-0.26	-0.25	-0.23	-0.24
PI	11	-0.19	-0.19	-0.25	-0.24	-0.20	-0.24
PI	12	-0.14	-0.15	-0.21	-0.19	-0.16	-0.17
VI	13	-0.12	-0.12	-0.16	-0.14	-0.14	-0.15
PI	14	-0.10	-0.11	-0.13	-0.13	-0.11	-0.12
VI	15	-0.03	-0.04	-0.07	-0.07	-0.07	-0.09
GI	16	-0.01	-0.02	-0.06	-0.05	-0.03	-0.04
GI	17	-0.09	-0.10	-0.14	-0.14	-0.10	-0.12
GI	18	-0.02	-0.03	-0.08	-0.09	-0.08	-0.08

* I = Inattentive
PI = Physical Impulsiveness
VI = Verbal Impulsiveness
GI = General Impulsiveness

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Table 2 Correlations of the whole scale and sub-sections

	Start of Reception reading	Start of Reception maths	End of Reception reading	End of Reception maths	Year 2 reading	Year 2 maths
Total behaviour rating scale	-0.26	-0.30	-0.37	-0.37	-0.34	-0.35
Inattention sub-scale	-0.31	-0.36	-0.42	-0.42	-0.40	-0.41
Hyperactive/ Impulsive sub-scale	-0.14	-0.15	-0.21	-0.20	-0.17	-0.19

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